NOTES ON *TABANUS ATRATUS* SUBSP. *NANTUCKENSIS* HINE (DIPTERA)

By Norman S. Bailey
Biological Laboratories, Harvard University

In the course of my field work with the saltmarsh Tabanidæ during the summers of 1946 and 1947 some observations were made on this representative* of the black horsefly which occurs along the coast from New Hampshire to New York. Although adults are never abundant, their large size and noisy flight make them conspicuous on the marshes. During the 1947 season (from late May to September 11th) only 16 specimens (5 males and 11 females) were taken whereas hundreds of *Tabanus nigrovittatus* Macquart (Bailey, 1947) could readily be captured in a short time on almost any day from early July to late August. The first specimen, a male, was collected on July 12th on the Pine Island Marsh in Newbury. Stone (1938) notes June 19th as the earliest record at Dorchester, Massachusetts and Johnson (1919) gives the other seasonal extreme of September 8th at Rochester, New Hampshire. My latest record is a female from Pine Island on September 11th. There is something of interest in the fact that all of my earlier 1947 captures were males. The second one was taken at Ipswich on July 16th, two more on July 24th at Newbury, and the final male at the last mentioned locality on August 27th. Females, possibly of this subspecies, were seen annoying horses in a field above the Parker River saltmarshes on July 15, 1946. In 1947, however, the first female was observed, in the act of ovipositing, on August 19th. From that day until September 8th one or two were seen, and usually taken, on each of my almost daily trips to the marsh.

Pine Island is a partly wooded knoll, large enough for a few cottages, that lies in the midst of the saltmarsh somewhat less than half-way from the mainland proper to Plum Island. It is about a half of a mile from the up-

* My thanks to Dr. Joseph C. Bequaert for this determination.

land to the Island over a gravel road that rises only 2–4 feet above the marsh. Usually I drive along this causeway to the mid-section where a small ditch, running parallel to the road on the north, overflows to form a broken chain of small shallow pools. Where these begin I shift into low gear and drive on slowly while watching for Tabanids. The larger ones are readily seen and egg masses can frequently be spotted in this manner. It is convenient to turn in a driveway at the edge of the Island and then drive back to park beside the ditch wherever anything of interest has been noted. Ordinarily, ovipositing females are not easily disturbed and they may be casually approached without any special precautions.

My experience with the first female is of some interest in this respect. She was busy ovipositing on a blade of *Spartina glabra* Muhl. var. *alterniflora* (Loisel.) Merr. which grew thinly in the shallow water of the pond margin. They show a strong preference for scattered culms rather than dense stands and eggs were found only on this plant. It was about 4 p.m. when she was first observed as I drove towards the Island. (All time E.D.S.T.) There I turned and went back to park as indicated above. Then I crossed the ditch and skirted the pond to get a closer look at her. She seemed quite indifferent as I carefully moved to within a foot of her and even touched the tip of the blade she was laboring on. For several minutes I watched her lay her eggs in the manner so well described by Hine (1903, 1906) for *Chrysops callidus* O. S. and *C. moerens* Walker. Then I decided to return to the car for a container in which to take her alive. She was still at work when I got back, but just as I was reaching out to lower the jar over her she flew away. Her egg mass was probably nearly complete since she had been ovipositing for at least an hour by that time. It measured 15 mm. long by 5 mm. wide at the base. The eggs were glistening white then but by 6 p.m. had become dull and somewhat greyish. By 9:30 the mass was mottled greyish brown and subsequently darkened but slightly. The upper ends of the eggs are a bit darker, which gives the appearance of stripes on close inspection since they are so uniformly

placed in the mass. Cameron (1926) states that the darkening process takes about six hours for *Chrysops* eggs, which become jet black. He notes that the pigmentation develops much more rapidly in full sunlight than in the laboratory.

The egg mass of *T. atratus* Fabricius has been described in detail by Hart (1895), and Schwardt (1936) provided photographs which agree closely with Hart's description. Schwardt also states "*T. atratus* deposits its eggs in masses which are so constant in structural plan as to make specific determination of the egg mass readily possible."

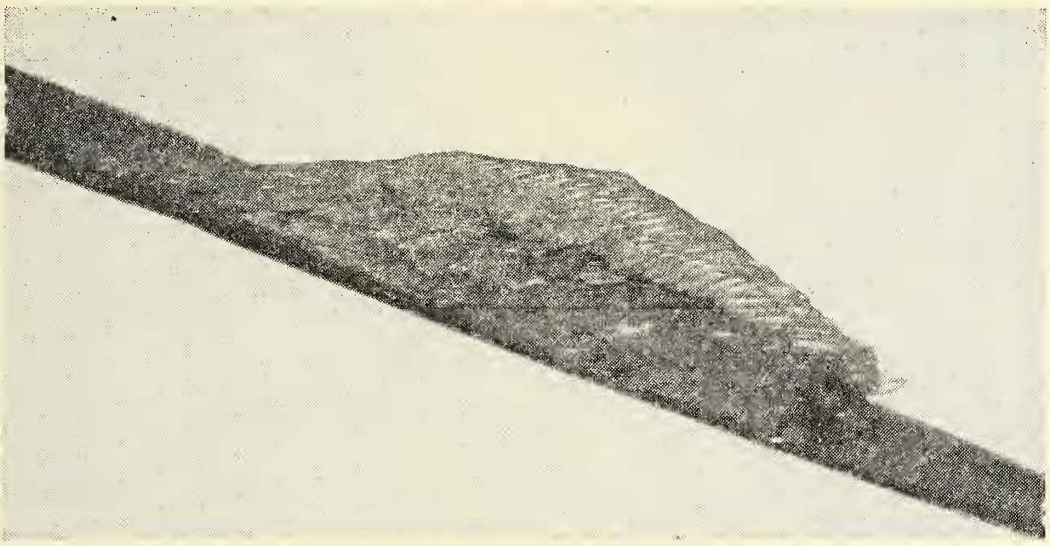


Fig. 1. Egg masses of *Tabanus atratus nantuckensis*. Photograph by Arthur F. Dewsnap, Jr. (About 4 × natural size)

This is especially noteworthy since the egg masses of the subspecies *nantuckensis* are strikingly different (see Figure 1). In the words of Hart (1895), *atratus* egg masses are "subconic, with oval base, 10–15 mm. long and 8–10 mm. wide, height 5–7 mm.; sides convex or concave, apex correspondingly rounded or pointed. . . . The eggs are stacked in four or five tiers, one above another, and gummed together in a firm mass." This is the type very rarely found on the saltmarsh where the usual form of the egg mass closely resembles the basal one in the accompanying figure.

The measurements given by Hart (1895) and by Stone (1930) suggest a maximum of 2:1 for the length to width ratio of *T. atratus* egg masses whereas those of the sub-

species *nantuckensis* have a minimum ratio of 3:1 and may be over 7:1. This difference in proportions is very characteristic and accounts for a marked difference in the appearance of the saltmarsh egg masses. They are no wider than the supporting grass blade while those of *atratus* may be twice as wide. There may be a possible connection between the more uniform exposure of the eggs in these thinner, extended masses and the temperature conditions of the coastal marshes. *Nantuckensis* egg masses vary at least from 15–35 mm. in length. However, they are very regularly only 4–5 mm. wide which is nearly the width of the *Spartina* blade. Generally they are laid in 2–3 well defined layers and at the highest point the mass will measure only 3–4 mm. Study of the figure will reveal that it is a photograph of a double egg mass. Horseflies not uncommonly add their eggs to previously deposited masses. However, the circumstances were somewhat unusual in this case.

About noon on August 22nd a restless female was seen flying from plant to plant along the border of the roadside ponds at Pine Island. She was apparently selecting an egg site, as subsequent events proved. After stalking her for several minutes, I succeeded in capturing her and put her in a small jar with a blade of grass bearing an egg mass that I had found shortly before. When I reached camp half an hour later she was already busily ovipositing directly over the older mass and continued without interruption until 2:05 p.m. She probably started to lay between 12:30 and 12:45 and, therefore, was so engaged for nearly an hour and a half. As the photograph clearly shows, she neatly arranged her eggs over the older mass. The picture was taken at 4:30 p.m. on August 23rd when the fresher eggs were about 27 hours old. The older ones beneath had hatched in mass early that morning.

The ovipositing behavior of two other females was sufficiently aberrant to mention. When discovered one had laid about three quarters of her eggs and the second had deposited about a third of hers. Those of the first were in three small discreet clusters on the same grass blade. She was put into a pint container with her eggs and while

there laid another little batch on the inside of the box. Very few of these eggs produced larvæ.

The other female was handled in the same manner. The form of her egg mass was not unusual, but she apparently lost her sense of direction in the darkness of the container and laid the rest of her eggs in a neat pattern well below the others and with her head up, facing them. This final batch was stacked in four tiers and was, consequently higher than usual.

Hine (1903) stated that, "Between nine o'clock and noon seems to be the favorite time of day for oviposition with the various species of both *Chrysops* and *Tabanus,* and I have seldom been able to observe females ovipositing at other hours of the day." My own observations for *nantuckensis* are just the reverse. All ovipositing was seen in the afternoon—from just after 12 until 5 p.m. However, Cameron (1926) is probably justified in saying that oviposition may take place at any time between 8 a.m. and 5 p.m. on bright days in June and July—and, I would add, in August. It is very likely that there is some such activity in the morning on the saltmarsh, but certainly it is not restricted to the forenoon hours in Essex County.

The incubation period was obtained for three egg masses. Hatching occurred in the early morning in one instance and probably at that time of day in the others. A mass deposited on August 19th hatched on August 26th after an incubation of seven days. The other two, laid August 27th and 29th, hatched on September 5th and 7th respectively after incubating 9 days. In each case the blade of grass was stuck into sand in a pint jar. Water covered the sand to a depth of half an inch and the eggs were at a level just below the rim of the uncovered jar in a relatively moist atmosphere. However, the containers were kept indoors and this probably lengthened the incubation period appreciably. The 7 and 9 day periods correspond with those similarly obtained by Hart (1895) and by Hine (1906), in that order, for *T. atratus* Fabricius, while Schwardt noted a 5 day period for eggs of this species in an outdoor insectary in Arkansas. Full sunlight undoubtedly hastens development.

Among the egg masses taken at the same Pine Island locality in 1946 were two, having all the characteristics described for known masses of *T. atratus* subsp. *nantuckensis,* from which hymenopterous parasites were reared. These were kindly identified for me as the Proctotrypid *Telenomus goniopis* Crawford by C. F. W. Muesebeck. As far as I have been able to ascertain, this species has previously been reported only twice. It was originally described from specimens reared by McAtee from eggs of *Goniops chrysocoma* (O. S.) found on Plummer's Island, Maryland in 1910 (Crawford, 1913). During the 1932 season Schwardt (1936) collected many egg masses of *Goniops* in Arkansas which were similarly destroyed. Therefore, this note reveals another host genus and a considerable extension of range. Although several egg masses were collected and reared in 1947, no parasites appeared. Most of these were taken while the flies were still ovipositing or were laid entirely in captivity. Consequently, they were not long exposed to normal environmental hazards. One of the parasitized egg masses was found on August 13, 1946 and the parasites emerged on August 20th. At the time of preservation, 54 specimens of *T. goniopis* (8 males and 46 females) had emerged. Others were still within many of the eggs. The relatively small number of males produced is apparently usual for this insect.

In reducing *nantuckensis* to a variety of *atratus* and in naming the variety *fulvopilosus,* Johnson (1919) calls attention to the considerable amount of variation seen in this species in coastal areas and raises the question of the influence of the environment as the agent responsible for it. Stone (1938) mentions the fact that many females have both the wing color that distinguishes *nantuckensis* and the lateral tufts of fulvous hairs just above the wing bases which are characteristic of *fulvopilosus.* It is of further interest to note that no males bearing such fulvous hairs have ever been collected. Five of the eleven females taken at Pine Island in 1947 (from August 20th to September 8th) had both varietal features. Two of them laid egg masses which were no different from others found

on the saltmarsh. It appears that these names designate the extreme forms in a population showing marked variability. Whether the basis of this variability is genetic, the result of physiological responses to environmental factors or, perhaps, both deserves investigation. Present evidence at least suggests that the *fulvopilosus* condition may be sex linked inheritance. Since there are females with both varietal characters and with no other recognized differences, the validity of distinct names seems questionable. On the other hand, if the form of the *atratus* egg mass has the specific significance indicated by Schwardt (1936), the status of *nantuckensis* needs clarification from this angle as well.

A few observations on the larvæ and pupæ demand notice. The former are most commonly found under mats and piles of straw and other plant debris which becomes stranded in soggy spots subject to frequent tidal flooding or sufficiently depressed to hold rain water. Where such trash lies on soft mud in very shallow water they are especially common. If uncovered they retreat by burrowing rather rapidly into the surface muck. Now and then one may be found in the thick algal mats on the surfaces of deeper pools. These saltmarsh larvæ closely resemble typical *atratus* larvæ as described by Walsh (1863), Riley (1870), Stone (1930), et al. but should be examined critically for possible differences. It would also be interesting to rear some under conditions comparable to (a) salt and (b) fresh marsh habitats to determine what influence, if any, the environment has in the production of the variation characteristic of the adults.

Pupal cases are often numerous in the drift left at the edge of the marsh by exceptionally high tides. This leads one to wonder at the relative scarcity of the flies themselves. The cases may also be found protruding from heaps of straw along the ditch banks. Yet only rarely are living pupæ encountered. One was located on the Parker River saltmarsh just east of Route I on July 17, 1947, and a male emerged on July 21st. This specimen was killed while still somewhat teneral and was reared indoors. The coloration of his wings is only slightly less uniform than in typical *atratus*.

Summary

Original observations on the seasonal distribution, abundance, oviposition, egg masses, incubation period, probable larvæ and the pupæ of *Tabanus atratus* subsp. *nantuckensis* Hine are given. Males were taken from July 12th to August 27th and females from August 19th to September 11th on the saltmarshes of Essex County, Massachusetts. A figure of two egg masses, one superposed on the other by a captive female, shows that the structural plan is notably different from that of typical *atratus* figured by Schwardt (1936) and noted by him to be specifically distinct. The ratio of length to width is not over 2:1 for typical *atratus* egg masses while those of the subspecies *nantuckensis* may be 7:1 and are normally at least 3:1. The incubation period was 7–9 days for egg masses kept indoors between August 19th and September 7th. Probable larvæ of this subspecies occur rather commonly in soggy mats of plant debris on bare mud or where shallow water covers the mud. Pupal cases are numerous in the marsh drift but living pupæ are only rarely recovered from the piles of straw. The question of the validity of the present status of these variants of *Tabanus atratus* Fabricius is raised. *Telenomus goniopis* Crawford is reported as an egg parasite of this species for the first time and with a notable extension of its range.

Bibliography

Bailey, N. S. 1947. Psyche, 54(1): 62–64.
Cameron, A. E. 1926. Bull. Ent. Res., 17(1): 14–17.
Crawford, J. C. 1913. Proc. U. S. Nat. Museum, 45: 243–244.
Hart, C. A. 1895. Entomology of the Illinois River, pp. 242–247.
Hine, J. S. 1903. Ohio Acad. Sci., Special Paper No. 5: 4–5.
1906. U.S.D.A. Tech. Series 12(II): 36–38.
1917. Ohio. Jour. Sci., 17: 271.
Johnson, C. W. 1919. Psyche, 26: 163–164.
Philip, C. B. 1947. Amer. Midl. Nat., 37(2): 302–303.
Riley, C. V. 1870. Second Missouri Report, p. 128.
Schwardt, H. H. 1936. Ark. Agri. Exper. Station Bull. 332: 14–15, 27–32.
Stone, Alan. 1930. Ent. Soc. Amer., Ann., 23: 261–304.
1938. U.S.D.A. Miscl. Publ., 305: 89.
Walsh, B. D. 1863. Proc. Boston Soc. Nat. Hist., 9: 304.